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Quantifying the Impacts of COVID-19 on US Aviation Economy

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Abstract: *The spread of COVID-19 pandemic at the end of 2019 has resulted the severe loss on US economy. The paper uses time series analysis based on the aviation data from February 2020 to September 2021 and other related information, the relationship of key factors is examined. The results turn out: (1) the causality relationship between passengers and aviation economy exists. (2) the unemployment rate has negatively affected the numbers of passengers. (3) the rate of IPI decreases by 1% in response to the increase of unemployment rate by 0.14%, whereas the numbers of passengers drop by 2.7% due to the same influence.*

Keywords: *COVID-19; US Aviation Industry; Shock Effect*

1. Introduction

The breakout of COVID-19 at the end of 2019 has severely stroke the global economy all over the world. Even worse, the COVID-19 epidemic has damaging consequences on the US airline industry. Before the epidemic, US airlines flew 28000 flights to the over 800 airports in more than 80 countries, transporting 28000 tons of cargo and connecting over 2.5 million of passengers. The Business Cycle Dating Committee of the National Bureau of Economics Research of United States has determined that the America has entered a recession from February 2020[1]. The governments from all over the world have announced that the international flights have been prohibited since in order to control the spread of pandemic and to alleviate the economic fallout, which resulted the intensely plummeted on the US airline stock prices [2].

2. Data and Methodology

2.1 Data

This paper analyses the monthly data from 21st January,2020, on which the first confirmed case was recorded, to September,2021. Also, all the variables in this paper are the percentages changed in a daily basis.

The US industrial productive index and unemployment rates are from the St. Louis Federal Reserve Economics Database. The numbers of airline passengers are from the website of the Transportation Security Administration. The confirmed cases of COVID-19 are the data reported to the CDC confirmed by the US. state and local jurisdiction from the previous day. Crude oil prices are from the St. Louis Federal Reserve Economic Data.

2.2 Methodology

Empirically, we employ the Sobieralski's method[3], the primary model used in this study is the vector autoregression(VAR) model. Introduced by Sims [4], the VAR models the dynamics of economic variables in time-series analysis.

3. Research Design

3.1 Choices of Indicators

Based on the previous researches, this paper finally chooses the US industrial production indexes as

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the indicator of the American aviation economy, instead of GDP. Also, the explanation variables are: COVID, the daily percentage of changes in confirmed cases; Passengers, the travellers screened at the checkpoint before boarding; the Unemployment rates and the Fuel price.

The VAR model used to examine the uncertainty shocks and their relationship to economic variables are given by:

$$y_t = c + \sum_{j=1}^{p} \Phi_j y_{t-j} + \varepsilon_t \quad (1)$$

Where yt is the vector of endogenous variables ordered uncertainty shocks indictors, Φ is the matrix of coefficient, c is the vector of constants, εt is the random error.

3.2 Coefficient Test

To eliminate collinearity between explanatory variables, this paper applies the coefficient test via EViews software and the results are as follows:

Table 1 The matrix of coefficient of variables

	Passengers screened	Unemployment%	COVID	fuel price
Passengers screened	1			
Unemployment%	-0.68	1		
COVID	-0.31	0.27	1	
fuel price	0.74	-0.77	-0.59	1

Based on the test results and the previous empirical research, it can be seen that Fuel has a strong correlation with Passengers and Unemployment, thus it has to be removed from the variables. Also, the IPI is added into the test to verify the correlation between variables, and the results are displayed as follows:

Table 2 The correlation between IPI and other variables

	Unemployment%	Passengers screened	COVID
IPI%	-0.912	0.785	-0.229

Due to the result from the test, the numbers of COVID confirmed cases is removed.

3.3 Vector Auto Regression

To estimate the parameters of the VAR, the variables used in the estimation are assumed to be covariance stationary. However, according to the empirical research findings, that the vector error correction model (VECM) is required if the variables in yt is not covariance stationary.

The augmented Dickey-Fuller (ADF) test will be conducted to investigate a test of the presence of a unit root in the variables[5]. The results of these tests are displayed as follows:

Table 3 Unit-roots tests

	Augmented Dickey-Fuller		
	Levels		1st
Variables	with a trend	without a trend	Difference
IPI	-5.685*	-3.3945	-5.1529*
Unemployment	-4.3543	-3.8666	-2.4899
Passengers screened	-3.2167	-3.313	-4.8351*

* Indicates rejection at the 1% level.

The null hypothesis of the test is that the process is a random walk or has a unit root. The appropriate variable lag length is determined by using an Akaike Information Criterion(AIC),likelihood ratio test and Schwarz Criterion(SC). Appropriate variable lag length is determined to be 4 and use the lag length will reduce the possibility of over parameterization.

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We fail to reject the null hypothesis for Passengers at levels and Unemployment at first difference, but reject the null hypothesis for IPI and Unemployment, as well as Passengers in levels without a trend. Therefore, these results combined suggest that the variables are covariance stationary without a trend.

Also, the test of cointegration is conducted using the Johansen test[6][7].

The results are displayed as follows:

Table 4 Cointegration tests

	Hypothesis	r=0	r≤1	r≤2
IPI	Trace Statistic	29.797*	15.495	3.8415

*Indicates rejection at the 1% level.

According to the test results, it indicates that we reject the null hypothesis and the cointegration exists.

3.4 Granger Causality Test

In order to testify the causality between variables, the Granger test is employed and the result is shown as follows:

Table 5 Granger causality test

	Lags 1		Lags 2		Lags 3		Lags 4	
H0	F-Statistic	Results	F-Statistic	Results	F-Statistic	Results	F-Statistic	Results
Passengers does not Granger Cause IPI	9.613**	Reject	4.968	Reject	8.4687**	Reject	4.8756	Reject
IPI does not Granger Cause Passengers	30.273**	Reject	12.425**	Reject	37.742**	Reject	0.0253	Reject
Unem does not Granger Cause IPI	0.1904		0.1026		0.211		0.5511	
IPI does not Granger Cause Unem	0.0129		0.00083		0.3696		0.4533	
Unem does not Granger Cause Passengers	10.652**	Reject	3.4051	Reject	9.6141**	Reject	0.6265	
Passengers does not Granger Cause Unem	1.8435		0.554		2.432		0.9792	

* Indicates rejection at the 1% level.
** Indicates rejection at the 10% level.

It can be shown from Table 5 that, the increase in the numbers of passengers and that in IPI have a two-way causality, whereas the growth rate of unemployment has a one-way causality with numbers of passengers. Specifically, only the passengers and IPI have the two-way causality, whereas the rate of unemployment has no causality with IPI.

The results from the Granger causality test have shown that the changes in the unemployment have a significant impact on the growth rate of passengers. In addition, the two-way causality between the passengers and IPI illustrates the increase of passengers may promote the aviation economy, and the prosperity of aviation economy may be a stimulus to the increase of numbers of passengers.

4. Conclusion

According to the research and we can find out: (1) the COVID-19 has a significant impact on the US aviation economy, specifically, the US unemployment rate and the numbers of passengers have a crucial influence on the aviation economy. (2) the rate of IPI decreases by 1% in response to the increase of unemployment rate by 0.14%, whereas the numbers of passengers drop by 2.7% in response to the 1% declines of IPI.

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